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AFPEA REPORT NO. 95-R-01
AFPEA PROJECT NO. 94-P-119

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**Development of Handling Frames and Shipping Containers for
250AH Lithium Thionyl Chloride Batteries**

**AFMC LSO/LOP
PACKAGING BRANCH
5215 THURLOW ST BLDG 70
WRIGHT-PATTERSON AFB, OH 45433-5540
March 1995**

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PROJECT: 94-P-119
TITLE: 250AH Lithium Thionyl Chloride Battery Containers

ABSTRACT

The Martin-Marietta Corporation in conjunction with SAFT of France developed six batteries that needed to be shipped from Poitiers, France to Cape Canaveral, Florida in a very short time. The Aerospace Corporation was tasked with solving this problem. Aerospace designed a Lexan/Aluminum handling fixture that they believed would satisfy the requirements, but they needed assistance with the design of a container and cushioning system and fabrication of the fixtures. The Air Force Packaging Evaluation Activity (AFPEA) was asked to provide assistance.

Each battery had to be shipped separately inside an 85 gallon steel drum which was UN certified for shipment of hazardous materials. A polyethylene cushioning system was designed that would attenuate shock to 30 G's and a self-contained transport recorder that would measure shock and temperature accompanied each battery.

AFPEA fabricated and assembled the Lexan/Aluminum fixtures. Handle pull tests were also performed on the fixtures to provide Aerospace with the required assurances that their handling fixture would perform adequately.

MAN-HOURS: 150

PREPARED BY:

PUBLICATION DATE:


12 5 APR 1995

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REVIEWED BY:

TED HINDS
Supervisor, Design Group
AF Packaging Technology &
Engineering Facility



APPROVED BY:

LESLIE K. CLARKE, III
Chief,
Packaging Branch




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INTRODUCTION:

BACKGROUND:

The Martin-Marietta Corporation in conjunction with SAFT of France developed six batteries that needed to be shipped from Poitiers, France to Cape Canaveral, Florida in a very short time. These batteries contain an unusually large amount of Lithium, which is a hazardous material. Hazardous material shipment requires special attention to detail and safety. The Aerospace Corporation was tasked with solving this problem. Aerospace designed a Lexan/Aluminum handling fixture that they believed would satisfy the requirements, but they needed assistance with the design of a container and cushioning system and fabrication of the fixtures. The Air Force Packaging Evaluation Activity (AFPEA) was asked to provide assistance.

REQUIREMENTS:

AFPEA was to provide six deliverable sets of air cargo only transportation packaging for the 250AH Lithium Thionyl Chloride batteries as defined on the Aerospace Corporation drawing SK 104-1 (appendix 1) and its details. The packaging conforms to the Aerospace Corporation drawing SK 101 (appendix 2). The first setup was intended to ship an inert 'pathfinder' battery to ensure the shock and environmental requirements were being met. A self-contained transport recorder was attached to each fixture in order to record the shock and temperature data.

DESIGN:

CONFIGURATION:

The outer container is an 85 gallon steel drum that is UN certified for shipment of hazardous materials. The cushion (appendix 3) is made from laminated 2pcf polyethylene foam and is designed to attenuate shock levels to 30G's. The fixture to which the battery is bolted is made from a combination of GE Lexan, a high strength plastic, and aluminum plate and bar stock. Because the battery is transported at low temperatures and is loaded into the container at 0°F and must be kept as cold as possible during transit, the fixture and battery assembly is double bagged with shrink wrap, wrapped with Armaflex insulation, and then sealed inside a double-wall fiberboard box.

TESTING:

TEST SPECIMEN:

A concern was raised about the strength of the fixture handles. A handle pull test was conducted. AFPEA had fabricated enough parts to make seven complete fixtures, so there was no concern about damaging any critical parts. The test specimen was a complete fixture loaded with lead blocks (nominal 50 lb/ea).

TEST PLAN:

See appendix 4.

TEST RESULTS:

A handling fixture was loaded with lead weights totaling up to 600 lbs and hung free of support by both handles and also one single handle. In neither case did the handles fail or show signs of fracture.

CONCLUSION:

The pathfinder battery container was completed and shipped on schedule. Results from the transport recorder showed shock levels well below the required 30 G's. The remaining batteries were to be shipped as scheduled because of the positive results seen in the pathfinder.

There was, however, a concern as to whether or not the handles were strong enough to provide a factor of safety of 2. A test was run to demonstrate the handle strength. Although the plain Lexan handles easily passed the pull test (Appendix 4), the users were not satisfied with the 'feel' of that configuration. An aluminum reinforcement was designed and installed on the remaining five fixture assemblies. With the newly reinforced handles, the remaining fixtures and containers were shipped without incident, successfully leaving France and arriving at Cape Canaveral.

APPENDIX 1
AEROSPACE DRAWING SK 104-1

APPENDIX 2
AEROSPACE DRAWING SK 101

ZONE	REV.	DESCRIPTION	DATE	APPROVED
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COMPLIES WITH CODE OF FEDERAL REGULATIONS
 TITLE 49
 SHIPPING DESIGNATIONS
 PROPER SHIPPING NAME: LITHIUM BATTERY,
 LIQUID CATHODE
 UN NUMBER: 3090
 HAZARD CLASS: 9
 PACKING GROUP: II

1. TWO STEEL BANDS
 1 1/2" TO 3/4" X 0.020
 UNDER TOP PALLET BOARDS ONLY

28.5 IN X 28.5 IN
 X 0.5 IN PLYWOOD

40 IN X 48 IN PALLET

48 IN MAX

4 FOR TRANSPORT OF DAMAGED OR DISCREPANT LITHIUM BATTERY. SEE SK 120

3. DEFINES ASSEMBLY FOR TRANSPORT EMPTY OR LOADED WITH
 ACCEPTABLE LITHIUM BATTERY.

2. STENCIL AND LABEL FOR SHIPMENT PER SK 110

1. MARKING FOR SHIPMENT AND STORAGE PER MIL-STD-129

NOTES:

THE AEROSPACE CORPORATION
 10000 WILLOW CREEK ROAD
 DALLAS, TEXAS 75243

250AH LITHIUM THIOMYL CHLORIDE
 BATTERY - TRANSPORTATION
 VIA AIR CARGO ONLY

DATE: 10-30-84
 BY: R. DENNO
 FOR: THE AEROSPACE CORPORATION

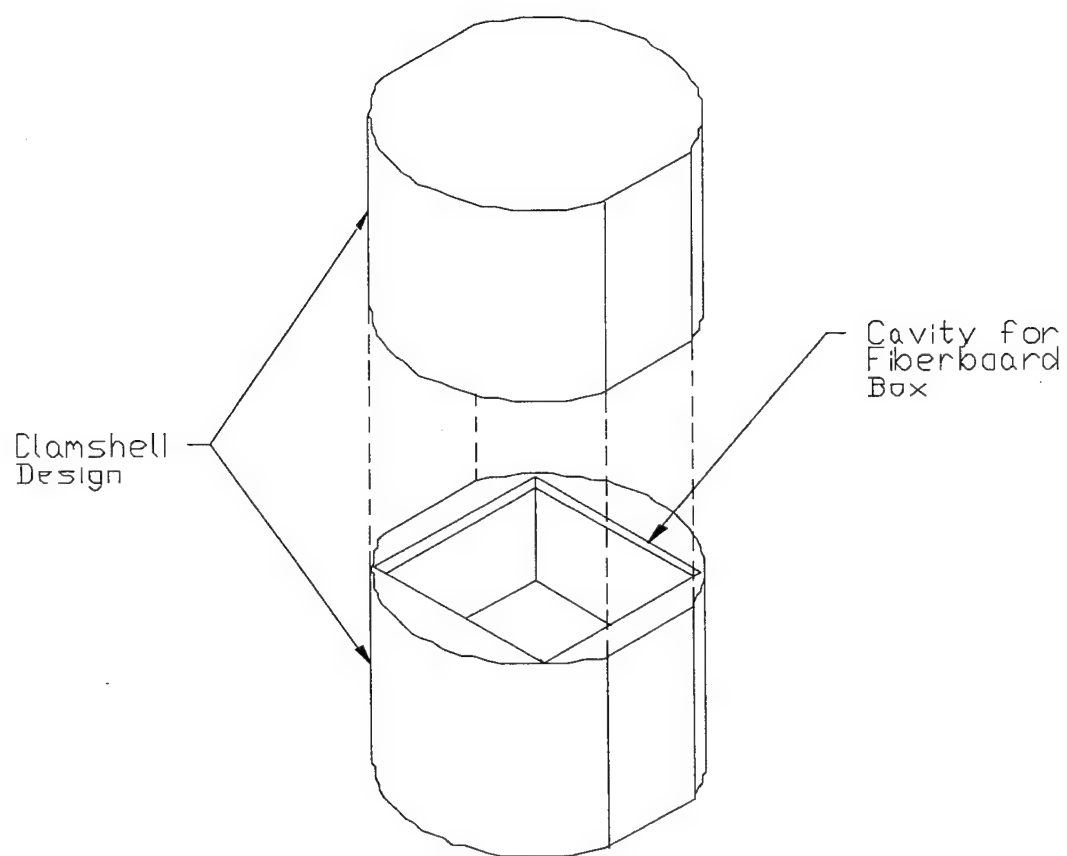
UN: 3090
 CLASS: 9
 GROUP: II

SK 101



1000

APPENDIX 3
POLYETHYLENE CUSHION



APPENDIX 4
TEST PLAN/RESULTS



DEPARTMENT OF THE AIR FORCE

AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE OHIO

MEMORANDUM FOR The Aerospace Corp.
2350 El Segundo Blvd.
El Segundo, Calif. 90245

FROM: AFMC-LSO/LGTP
5215 Thurlow Street
Wright-Patterson AFB OH 45433-5540

SUBJECT: Letter Report - 250AH Lithium Battery Fixture Handle Pull Test

1. Referencing telephone conversations between Dick Denno of Aerospace Corp. and Jason Gilreath of the Air Force Packaging Design Division, the Martin Marietta company felt the fixture handles were flimsy and would not satisfy a factor of safety of two (2) with a battery loaded in the fixture. Martin Marietta requested the Lexan handles be reinforced with aluminum plate in order to provide the needed strength.
2. A handle pull test was conducted to determine the acceptability of the existing handles. The 250AH Lithium Battery weighs 86 lbs. A test load of approximately 175 lbs would provide the required factor of safety of two (2). The first test consisted of a loaded fixture hanging free of support by both handles from a 2 inch wide cargo strap. The second test was to hang the loaded fixture by one single handle, also using a 2 inch wide cargo strap.
3. For both configurations, a lead test load of 600 lbs was used. This weight gives a factor of safety of approximately five (5) for two handles, and over ten (10) for a single handle. The maximum deflection when both handles were used was approximately 0.5" each (see figures 1 and 2). The maximum deflection for the single handle configuration was approximately 0.625" (see figures 3 and 4). In neither case did the handles fail or show signs of fracture.
4. Our point of contact is Mr. Jason Gilreath, at DSN 787-3362 or Comm (513) 257-3362, FAX 257-0231.

Leslie K. Clarke, III
Chief, AF Packaging Division

Attachment:

1. Figures 1 thru 4

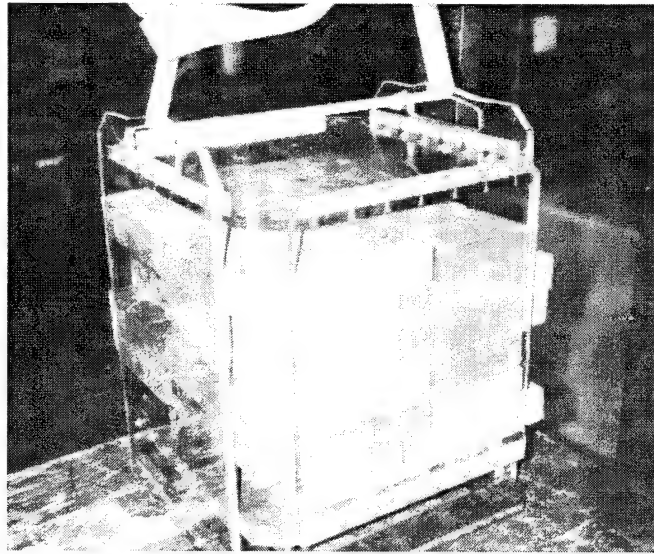


Figure 1

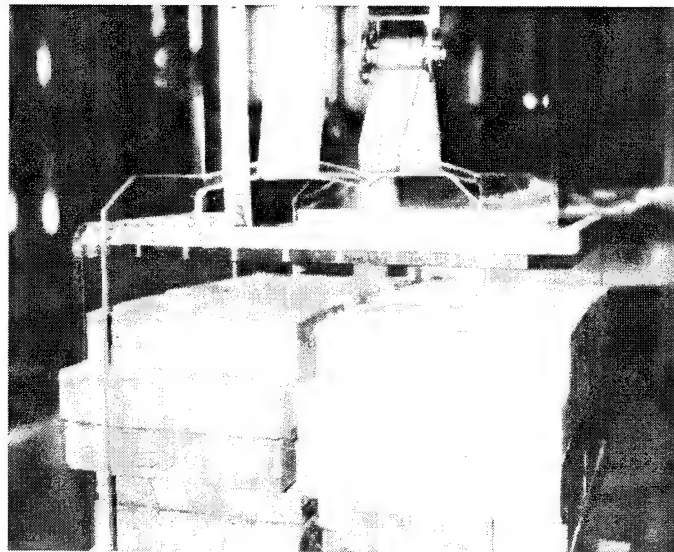


Figure 2

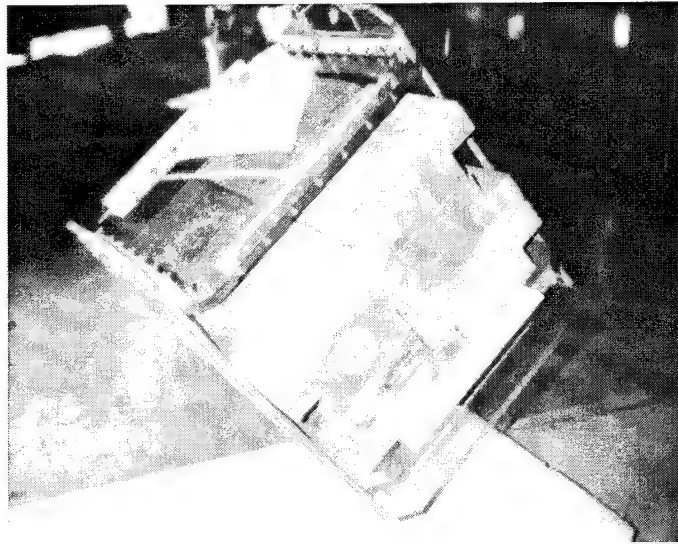


Figure 3

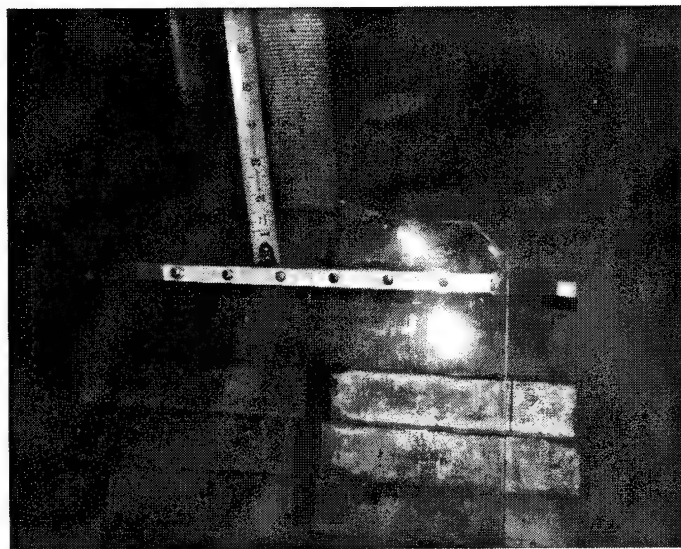


Figure 4

APPENDIX 5
DISTRIBUTION LIST

DISTRIBUTION LIST

DTIC/FDAC CAMERON STATION ALEXANDRIA VA 22304-6145	1
HQ AFMC/LG WRIGHT-PATTERSON AFB OH 45433-5006	1
AFMC LSO/LO WRIGHT-PATTERSON AFB OH 45433-5006	1
AFMC LSO/LOP (LIBRARY) WRIGHT-PATTERSON AFB OH 45433-5540	10
HQ USAF/LGTT WASHINGTON DC 20330	1
654 ABG/LGT 7701 SECOND ST, STE 209 TINKER AFB OK 73145-9100	1
654 ABG/LGTP 7701 SECOND ST, STE 209 TINKER AFB OK 73145-9100	1
649 ABG/LGT BLDG 1135 7973 UTILITY DR HILL AFB UT 84056-5713	1
649 ABG/LGTP 7530 11th ST HILL AFB UT 84056-5707	1
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NAVY SHIPS PARTS CONTROL CENTER
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US ARMY NATICK LABS/STRNC-ES NATICK MA 01760	1
HQ AFMC/LGSH WRIGHT-PATTERSON AFB OH 45433	1
ASC/SDM WRIGHT-PATTERSON AFB OH 45433	1
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ATTN: DLA-AT DEFENSE CONTRACT MANAGEMENT COMMAND CAMERON STATION ALEXANDRIA VA 22304-6190	1
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RICHMOND VA 23297-5000

ATTN: DICK DENNO 1
M6/206
THE AEROSPACE CORPORATION
P. O. BOX 92957
LOS ANGELES, CALIFORNIA 90009

ATTN: MAJOR KEVIN KLONOSKI 1
2420 VELA WAY SUITE A5-1467
LOS ANGELES, CALIFORNIA 90245-4659

APPENDIX 6
REPORT DOCUMENTATION

REPORT DOCUMENTATION PAGE

Form Approved

OMB No. 0704-0188

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25 Apr 95

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Final Aug 94 - Mar 95

4. TITLE AND SUBTITLE

Development of Handling Frames and Shipping Containers for 250AH Lithium Thionyl Chloride Batteries

5. FUNDING NUMBERS

6. AUTHOR(S)

Jason Gilreath

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

AFPTF
AFMC LSO/LOP
Bldg. 70, Area C

8. PERFORMING ORGANIZATION REPORT NUMBER

95-R-01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release. Distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This report is to document the design and fabrication of six shipping containers/assemblies for the 250AH Lithium Thionyl Chloride batteries manufactured by the Martin-Marietta Corporation in France. The handling frame is a combination of aluminum and GE Lexan. The cushion system is polyethylene foam, and the outer container is a UN-certified steel drum. The container passed a field test (shipment of a unit through the supply system). The containers were fabricated wholly in-house at the Air Force Packaging Technology & Engineering Facility.

14. SUBJECT TERMS

250 AH Lithium Thionyl Chloride batteries,
Lexan handling frame

15. NUMBER OF PAGES

14

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT

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18. SECURITY CLASSIFICATION OF THIS PAGE

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19. SECURITY CLASSIFICATION OF ABSTRACT

Unclassified

20. LIMITATION OF ABSTRACT